Innovating for tomorrow's mobility and services

PORTFOLIOS OF EXPERTISE

RATP GROUP

explore te

INNOVATION IN THE GROUP

240
ongoing innovation **projects** to facilitate passengers' daily commute and to imagine the cities of the future

Over
60
theses completed as part of a Cifre (industrial convention of education through research) contract

22
start-ups
accelerated since 2020

Over
180
partners

1
VOX participatory innovation **programme.** Within two years:

- **2,100** participants
- **780** ideas submitted
- **37** projects under development
- **11** solutions deployed

4
innovation **labs**
(Brest, Casablanca, Paris and Val-de-Fontenay)

st implement

Innovation is what defines RATP Group.
Who invented rubber-tyred metros, automated long-established metro lines, trialled autonomous vehicles and hydrogen-powered buses, and also deployed projects to reduce energy consumption (new braking systems, energy management, geothermal energy and much more)? RATP's history has been marked by major breakthroughs and ambitious development efforts to create sustainable and safer mobility solutions, and invent new urban services.

The Group's innovation strategy has always been aligned with its fundamental missions: **make daily life easier for its users, and increase the appeal of cities.** Going beyond the technologies and behind-the-scenes research, innovation at RATP Group is first and foremost a method applied from the trial phase to the industrialisation phase. Who stands to gain: passengers, employees and regions.

It is also a powerful tool for co-design and openness, creating a conducive environment for the company to interact with its ecosystem through partnerships, lab networks and numerous collaborations with start-ups. Within the Group, innovation encourages cross-disciplinary collaboration, transforms working methods and thus contributes to improving employees' quality of life.

Mobility trends ahead

Autonomous vehicles, seamless and accessible journeys, predictive maintenance and new decarbonised energy sources are among the emerging new patterns in mobility. Backed by the widespread expansion of generative AI, virtual or augmented reality, ultra-connectivity and greentech innovations, they look set to define the future of mobility. We focus on the five major trends observed at the CES 2023 (Consumer Electronic Show) in Las Vegas.

Consumer Electronic Show 2023

No. 1
international trade show devoted to **technological innovation**

3,200
exhibitors

1,000
start-ups including **200** French start-ups and companies

150
countries represented

115,000
visitors

Virtual simulation with digital twins

The large amount of data available can be processed to create 3D virtual clones of structures. Through 3D simulation, procedures and decision-making can thus be optimised over the entire project life cycle: validation of feasibility, prototyping, adaptation, upgrades, predictive maintenance, and so forth. Virtual simulation applied to real estate, maintenance sites and mobility can, for example, make it possible to test automated driving technologies on a large scale over billions of virtual kilometres.

Augmented reality as a tool in decision-making

Making decisions in complex environments by navigating virtual worlds that mirror spaces in the real world constitutes the crux of augmented reality in an industrial context. With assisted maintenance, technicians are more accurately guided on the field during their operations, thanks to information that appears on their glasses. This technology continues to be developed to increase its efficiency.

Energy-efficient electrical recharging

At the forefront of decarbonised mobility solutions, electrical energy goes hand in hand with efforts to combat climate change. Innovation is key in this field, to ensure, for example, the autonomy of electric vehicles without energy loss. New systems optimise inductive recharging through a portable terminal placed under electric vehicles, thus eliminating the need for model-specific connectors.

The importance of sensors and data

The development of connected vehicles fitted with sensors and apps is currently expanding. These vehicles integrate control units interconnected via embedded networks and connectivity devices (IoT, Cloud, 5G, Bluetooth, and more). Information exchanged, both inside the vehicle and with its environment, makes it possible to manage and guarantee the vehicle's safety while providing entertainment to its passengers.

Acceleration of real-time information using artificial intelligence (AI)

The rapid development of ChatGPT in a matter of months has shown the world what AI can do. Applied in a conversational context, this form of AI is only the tip of the iceberg regarding a revolution set to transform user habits in numerous fields. In mobility, for example, AI has shown significant potential in its ability to provide passengers with information in real time, and facilitate their access to mobility.

INSIGHT FROM THE EXPERT

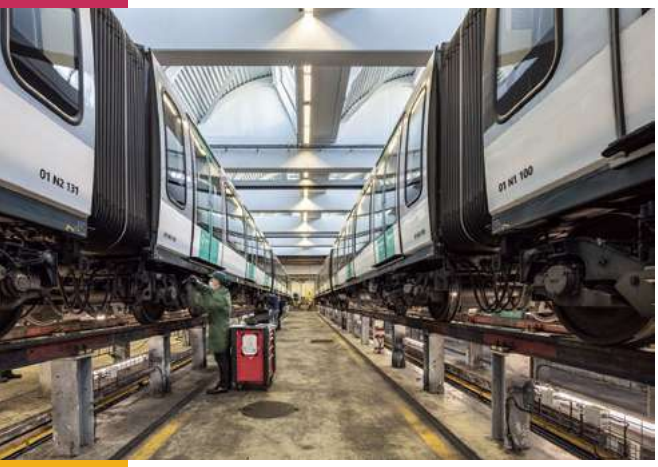
Dominique Servier-Crouzat,
Head of strategic innovation programs, RATP Group

"The CES has highlighted the boom of the metaverse, which combines virtual worlds, augmented reality and the Internet, with smart devices such as increasingly high-performing glasses. In autonomous mobility, vehicle fleets managed in taxi or public transport mode have become a reality in major American cities, with their ability to accept legal and safety requirements equivalent to what a human being expects. This is yet to be the case in Europe. What struck me the most, however, is the surprisingly little attention the trade show gave to energy efficiency at a time when climate stress is at its highest."

Innovating
daily for a richer passenger experience

P. 8 — p. 13

RATP Group relies on artificial intelligence to improve traffic regularity and guarantee smooth journeys. Data collected from its various systems (ticketing, operations, etc.) is processed for these purposes by algorithms developed either in-house or with partners. The Group extends this partnership-based approach to all its areas of innovation; its innovation labs and ecosystem work towards providing a richer, more seamless passenger experience.



Boosting
industrial excellence

P. 14 — p. 19

RATP Group's brand of innovation also aims to increase industrial excellence. With predictive maintenance, an AI-powered technology, breakdowns and incidents can be anticipated, thus making it possible to improve security on the Group's transport networks and to optimise their efficiency. And to improve the working conditions of several thousand staff members, the Group has been developing new physical assistance technologies (NTAP) that minimise the physical impact of maintenance activities and facilitate the decision-making process through augmented reality.

Developing
new decarbonised mobility solutions

P. 20 — p. 23

One of the 21st century's major challenges, the ecological transition lies at the core of RATP Group's innovation strategy. While RATP's mission as a public transport operator already requires it to offer alternative solutions to private car use, the Group leverages innovation to scale new heights in its climate commitments. New energy, autonomous buses and shuttles and soft mobility are some of the ways in which RATP Group innovates to invent the new decarbonised mobility solutions of today and tomorrow.

Committing
to better city living

P. 24 — p. 28

RATP Group's operating network has natural resources (thermal and free heat, mine water, among others) and land assets with which it innovates to serve the interests of the city and its residents. Aware of the need to enhance the quality of city living, the Group is developing innovative solutions to soften the impact of its activities, improve the efficiency of these solutions and preserve resources. At the same time, the social innovation projects led by the Group in partnership with regional stakeholders act as an additional lever to create cities that are more open, inclusive and peaceful.

INSIGHT FROM THE EXPERT

Frédéric Tran Kiem,
Group Director, Digital technology, Information systems and Innovation

"Regardless of purpose – improving passengers' daily commute, employees' working conditions and industrial processes, or decarbonising cities to make them more resilient – innovation is a requirement in which we are investing a significant amount of energy and resources. Innovation is imperative in upholding the quality of service that our customers expect. We consider it, above all, a powerful business accelerator and lever to attract talent."

Innovation, a strong feature of the Group's identity

Since its creation, RATP Group has tirelessly innovated for the benefit of passengers, cities and regions, and continues to find ways to improve its employees' working conditions. Having led the way with many world firsts, the Group has positioned innovation at the heart of its strategy, and fosters collaborative innovation. The Group also develops partnerships with industry and academia, and draws from its circle of the most promising start-ups.

1. THE GROUP'S INNOVATION ECOSYSTEM

Through participatory innovation challenges (RATP Dev's Innov & Go and *Les Mains en Or* in RATP maintenance teams), employees have been motivated to channel their knowledge, practices and fields of expertise towards inventing tomorrow's solutions, and deploying them on the widest scale. In the *Les Mains en Or* challenge devoted to maintenance teams, shortlisted ideas are shared with all employees for their evaluation via the VOX, the Group's participatory innovation platform. End-to-end collaborative innovation!

2. PARTNERSHIPS

The Group collaborates with industrial, institutional and academic partners such as the *École des ponts et chaussées* and the Massachusetts Institute of Technology. These partnerships may take the form of consortia such as the Rail Open Lab, in which 30 partners (major corporate groups, SMEs, medium-size companies and start-ups) join forces to imagine the rail network of the future (see page 15). Working together with regions, RATP Group develops partnerships that encourage urban pilot projects (Paris&Co) and the creation of innovation ecosystems on a regional scale *(Rêve de scènes urbaines)*.

1952 First trial of automated driving systems

1967 Commissioning of the first centralised control room on metro line 1

1998 Commissioning of metro line 14, the first fully automated large-capacity line in the world

2012 Automation of metro line 1 without any major traffic interruption on one of the longest standing metro lines

2016 First trial of an autonomous shuttle on the Georges-Pompidou pedestrian walkway in Paris

3. LAB NETWORK

Created in September 2018 to accelerate RATP Group's transformation and boost its innovation policy, Urbanopolis is a network of innovation labs that share the same goal: bring out good ideas and accelerate innovation within the Group and its subsidiaries. Urbanopolis collaborates with the cities in which these labs are established. Located in France and Morocco, these labs quickly test the viability of an innovation and design its business model to assess the benefits of industrialising it.

INSIGHT FROM THE EXPERT

Gilles Tauzin,
RATP Group Innovation Director

"Innovation is deeply rooted in RATP's culture as heritage from its history, driven by technology and developed with our many partners, including start-ups."

3.

OUP'S
ATION
STEM

4.

4. COLLABORATION WITH START-UPS

Two approaches describe this mode of collaboration. On the one hand, RATP Capital Innovation, the Group's investment and start-up subsidiary, invests in new forms of mobility. This is the case with the start-ups Zenpark, a connected shared parking operator, and Electra, which offers fast-charging solutions. On the other hand, the Group offers tailored professional guidance via its start-up programme and, notably, its accelerator. Five winners are supported every year over a six-month period by the accelerator programme, during which they have the possibility of testing and deploying their solutions on networks operated by the Group.

2017 Electric conversion of the 21 buses on route 341

2018 First multi-modal global transport operator to be awarded ISO 50001 certification (energy management)

2019 First MaaS (Mobility as a Service) trial in the Île-de-France region in partnership with Île-de-France Mobilités

2021 Operation of the first hydrogen-powered bus by RATP Dev subsidiary CTY

Trials with real-time translation app TradIV.IA, to facilitate communication with foreign tourists

2022 Trial deployment of Perceval, a robot dog, with infrastructure inspection teams

2023 Large-scale deployment of exoskeletons for Group maintenance teams

Innovating every day for a better passenger experience

To enhance the global passenger experience, the Group continuously innovates to improve all aspects of the journey, notably to provide clear and accessible information.

AI, STRATEGICALLY DRIVING INNOVATION

Artificial intelligence (AI) represents a strategic challenge for RATP Group. Launched in 2019, the AI programme aims to capitalise on this technology to increase efficiency and lead ground-breaking projects targeting passenger comfort and confidence. Working across all entities, the AI programme covers the entire range of the Group's activities (operations, maintenance, passenger information, etc.) under 8 thematic fields. On the one hand, it integrates external technologies that it then adapts to the various entities. On the other hand, it develops AI in-house to directly cater to entities' needs. Through this dual approach, the Group can then hone its AI skills while the entities can use these new technologies to improve passenger experience. This has proven to be an effective method in the over 40 projects launched since 2019, 75% of which have moved on from the industrialisation pilot stage to industrial deployment within the Group.

KNOWING MORE ABOUT CROWD LEVELS TO IMPROVE PASSENGER COMFORT

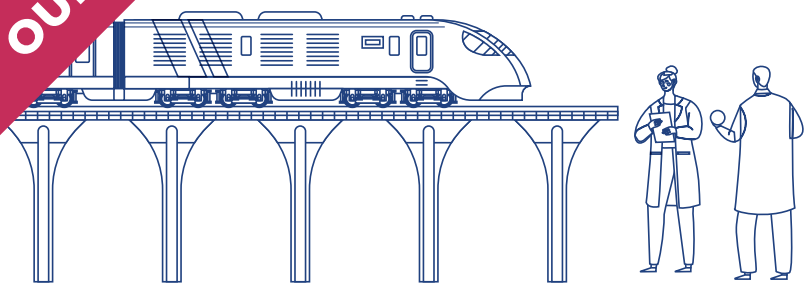
Based on the observation that passengers are reassured when they have real-time knowledge of crowd levels in metro stations and on trains, the AI programme has devoted two innovative projects for that purpose. The first, IAffluence Flux & Espace, counts the number of passengers in all stations in real time. Apart from providing more granular knowledge of the network, the project makes it possible to better adapt stations to actual crowd conditions, thus increasing passenger comfort. In the same vein, the IAffluence Bord project measures crowding in the various carriages of rolling stock. Passengers can then benefit from accurate information on the actual occupation of arriving trains, and choose which carriage to enter accordingly, or wait for the next train.

Trial of IAffluence on metro line 14.

DATA AT THE HEART OF AI

Armed with data, we can better predict crowd levels, or optimise the distribution of our staff in stations, along with many other possibilities. During an international sporting event, data can facilitate the strategic deployment of staff whose profiles are most suited to the event.
We are also fine-tuning the predictive maintenance of equipment in stations to offer passengers improved comfort and safety.
To secure the future of the Group, a key challenge involves forging partnerships with regions to gain a better understanding of mobility, and use this knowledge to develop smart cities and improve passenger satisfaction.

OUR PROJECTS



All The Way

A major advantage for tourists

All The Way, a start-up created in November 2022 with support from RATP Group and its partners Accor Hotels and Air France, offers air travellers a luggage check-in service in central Paris. Passengers can check in their bags at partner venues (hotels, trade shows, major sporting events, etc.) and retrieve them at the airport in their destination cities. A premium solution offering a bag pick-up service also exists, as well as the possibility of delivering luggage from the destination airport to the passenger's hotel or home. The solution is managed by certified operators. As a partner in VivaTech and the Rugby World Cup, All The Way aims to transport 50,000 bags in 2023, and 250,000 bags in 2024.

Osons le bus

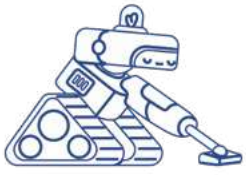
As part of the *Osons le Bus* (Taking the bus is easy) programme in Boulogne-sur-Mer, RATP Dev has launched several Ateliers mobilité® workshops that seek to support, inform and educate people with specific needs (children, seniors, people with reduced mobility, job seekers and others) on how to use the bus network. A total of 400 people took part in these workshops, at the end of which 12 test offers were proposed. A third of the attendees signed up for a subscription at the end of the trial period. This innovation uses the collaborative approach to passengers' benefit, to facilitate and encourage the adoption of public transport.

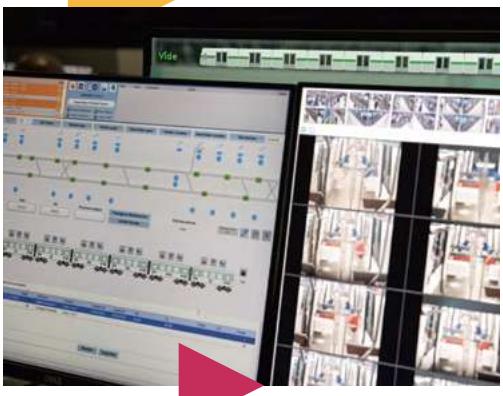
StopBus

Bus routes 92, 128 and 188 at the Montrouge bus depot are trialling a digital solution that makes it easier to request a stop on board the bus, notably for people with visual disabilities. Blind or visually impaired passengers can use their accessibility remotes or smartphones to request a stop during their rides. Backed by Île-de-France Mobilités, the system makes bus travel even more accessible, in line with RATP Group's goal of providing more inclusive mobility.

Scan a QR code
for cleanliness and comfort

On Paris metro lines 2, 13 and 14, QR codes have been added on board trains so that passengers can report equipment breakdowns, or unsanitary or uncomfortable conditions. By simply scanning the QR code with a smartphone, passengers will be redirected to a web page on which they can enter details of their complaint, and upload a supporting photo. The relevant teams will then receive an e-mail alert and can organise an operation depending on the urgency of the action required. The service will be trialled on tram line 7, and subsequently deployed in stages on the rail network.





Service regularity
(DetectIA)

Another service quality challenge: train frequency. One more innovation, DetectIA Voies de service (DetectIA – service tracks), detects the presence of passengers remaining on trains at the terminus. Currently deployed on metro line 14, the system relies on artificial intelligence algorithms and computer-assisted vision. What are its advantages? It reduces the impact of operations at the terminus, prevents traffic disruptions and ultimately makes the network run more smoothly. It can be easily replicated on automated lines, and in the long run, has the potential to benefit all lines equipped with built-in cameras.

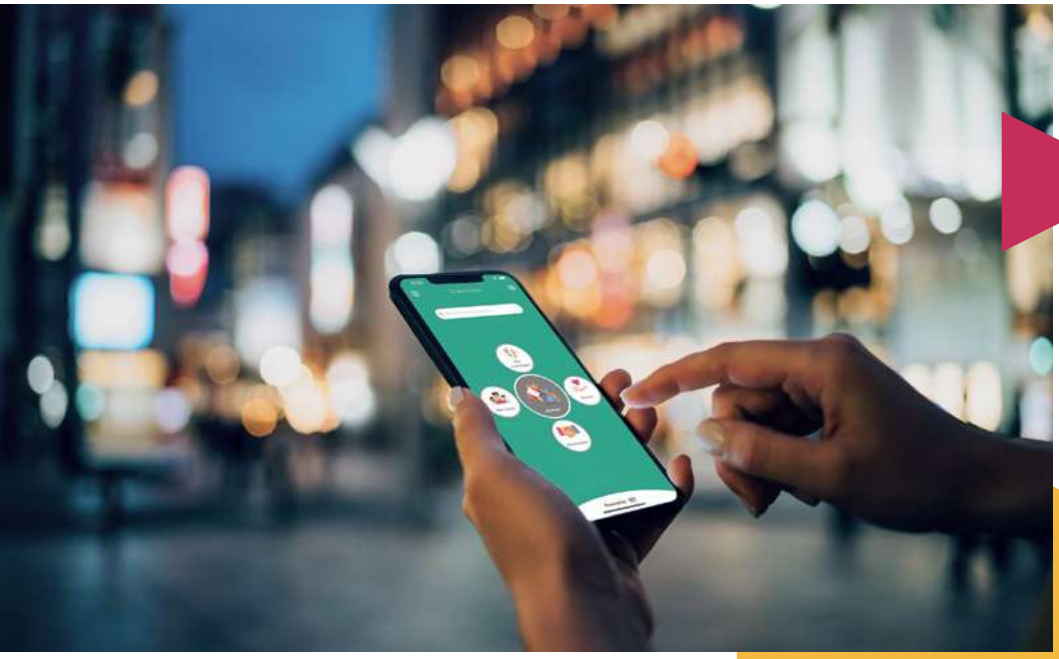
Building together to invent tomorrow's solutions

URBANOPOLIS, ENCOURAGING INNOVATION THROUGH A NETWORK OF LABS

The four laboratories in the Urbanopolis collaborative innovation network have been jointly developed by RATP Group and its subsidiaries in France (Paris and Brest) and Morocco (Casablanca), to devise new ways of working, and to accelerate innovation that will enhance tomorrow's cities and their residents' lives. What's original? Co-creating with input from the ecosystem and regions to deploy innovative solutions and share the most suitable best practices. Through this approach to innovation, the Group can optimise the way it works, open up even more to the rest of the world – notably together with start-ups – and channel the entire Group's energies to more effectively promote its expertise.

KER'LAB, MOBILITY FACILITATOR IN BREST

Deployed as a partnership between RATP Dev and the Brest urban area, innovation lab Ker'Lab will support the city in the sustainable development of its mobility network until 2027. What this means is that Ker'Lab will provide residents in the Brest urban area with innovations that will facilitate their daily mobility. Some of its projects include: the trial of an electric bike-sharing service, and the first trial of the Walk In Peace app (see opposite) open to the general public, aiming to make users feel safer on the network. The lab regularly hosts collaborative workshops for public transport users and Brest-based ecosystem partners (organisations, schools, universities and more), to imagine tomorrow's mobility together.



WALK IN PEACE, AN APP FOR SAFE WALKING ROUTES

With the Walk In Peace (WIP) app, users can plan their routes with travel companions recommended by other users based on a rating system. Developed by Casablanca-based innovation lab Casaroc, in collaboration with university students and passengers during a hackathon, this app addresses the issues of solidarity and safety in public transport, notably for vulnerable users and people with reduced mobility. In an emergency, the app can set off an alarm and send a notification to call for help. The service was tested among Group employees in the Île-de-France region, and then adapted by Ker'Lab for Brest. It will soon be tested on part of the network in Paris.

INSIGHT FROM THE EXPERT

Chloé Le Gall,
Head of Ker'Lab

"Ker'Lab leads innovative approaches with participants from the Brest ecosystem, mainly universities and higher education institutions, to identify its residents' mobility needs. For RATP Dev's Brest subsidiary Bibus, it is a catalyst for innovation, regardless of whether it results from the local ecosystem's initiatives or more directly from the Group. After the trial phase, the main aim of the solutions that we implement is to effectively meet the actual needs on the ground."

Boosting industrial excellence

In increasingly complex environments, innovation represents one of RATP Group's levers for industrial excellence, with a multitude of ways in which it can be applied to the Group's various entities. A prime example of the Group's innovation is predictive maintenance, at the core of its expertise and processes, which aims to take excellence to new heights on the entire transport chain.

ANTICIPATING BREAKDOWNS WITH PREDICTIVE MAINTENANCE

Ordinarily, metro trains can be taken out of circulation for preventive maintenance when they have reached the configured number of kilometres. However, if they are taken out of circulation due to a breakdown, this is referred to as corrective maintenance, which incurs significant cost (operational, financial, etc.). Thus, anticipation is essential to prevent, or even better, predict such incidents. Data gathered from sensors built into trains and tracks now makes it possible to find out the health status of assets in real time, and throughout their life cycles. By analysing captured data, not only can breakdowns be anticipated, but the right operations can also be conducted immediately. A cutting-edge tool to detect rail defects or anticipate breakdowns on sliding doors on automated metro lines, predictive maintenance can also use data to accurately predict temperature peaks likely to distort rails three days in advance. It is the perfect illustration of how technology such as artificial intelligence can become tools built into processes to improve operations. A true industrial revolution for enhanced performance.

Our goal from 2026
is to equip
30%
of our metro lines
with predictive maintenance
solutions, thus improving
service quality by reducing
the frequency of breakdowns

Vincent Dimanche,
Head of the predictive maintenance programme and Head of the Rail Open Lab project

INSIGHT FROM THE EXPERT

"Innovation-wise, one of the Group's biggest works in progress, and the one that will drive efficiency, is successfully framing data at the core of all our activities, to help the company make clear, informed decisions, thanks to ethically obtained, high-quality data. To reach this goal, we must already start aiming high. We are currently working on our road map so that we can be fully data driven from 2040 onwards."

CIRCULAR INNOVATION

To reduce its rolling stock's impact on the environment, RATP Group is extending their life span by upgrading and improving "old" trains to put them back into circulation. The first MP 89 CA trains that used to service metro line 14 were introduced on metro line 4 when it became fully automated. Transferring these trains made way for MP 89 CC trains, which began their re-deployment on metro line 6 in January 2023 and are expected to be fully deployed by 2026. Metros are not the only rolling stock to be given a new lease on life. Old buses have been sent to Lebanon, where they will enter circulation.

With Rail Open Lab

the rail network of the future

Rail Open Lab, the rail industry's open innovation project accelerator, is an association created by labour union SERCE, the FIF (French federation of railway industries), RATP and SNCF Réseau. The association brings together approximately 30 partner organisations to design the rail network of the future. These organisations range from corporate groups to SMEs, medium-size companies and start-ups. Together, they innovate to find solutions under four digital themes of the future: predictive maintenance, smart collaboration, connectivity, and the circular economy – sustainable development. The use cases proposed by project partners will be tested directly on the rail network under real operating conditions over a four-month period. Since its creation in 2018, 35 projects have led to the design of 16 solutions with highly promising prospects for industrialisation, notably the rail defect detection project (see opposite).

2023
the Rail Open Lab was named the winner of the Data Sharing category by the AIT (French transport innovation agency)

With Alstom

detection of defects on rails

Operating under the Rail Open Lab, RATP Group and Alstom are currently leading a rail analysis project, which aims to deploy a system that detects rail fissures via ultrasound waves. The solution indicates the structural health status of rails in real time, and can, for example, detect the beginning of a fissure in less than an hour without the need for human intervention. Once this project is industrialised, it will provide granular and accurate information on the structural health status of rails, and deploy a predictive rail maintenance solution across the RATP network.

INSIGHT FROM THE EXPERT

Sébastien Clément,
R&D Program Manager, Alstom

"Alstom has provided RATP Group with an innovative rail defect detection solution: Rail SHM (Structural Health Monitoring), which relies on cabinets placed on the edges of tracks, and sensors attached to rails. The solution was implemented as part of the Rail Open Lab, during which we were able to test it under real operational conditions across the RATP network over a four-month period. We are currently working together on setting up a new, longer-term partnership, to extend the project until April 2024.
As trains are one of the key transport modes of the future to combat global warming, we must continue to devote a significant amount of innovation to them!"

Improving the quality of working life

At RATP Group, improving the operation of its bus and metro lines involves the maintenance of rolling stock and the rail network, which occasionally requires staff members to exert great physical effort. The Group is trialling and developing new physical assistance technologies to relieve employees in their most gruelling tasks and thus improve their working conditions.

IMPROVING THE QUALITY OF WORKING LIFE

Quality of working life is a priority area for RATP Group. As solid proof of the Group's commitment, the new physical assistance technology (NTAP) programme focuses on several technological fields in the industry of the future: exoskeletons, smart robotics and cobotics, i.e., collaborative robotics, in which robots work with humans. Through this programme, the Group also innovates in augmented reality, virtual reality and smart individual protection devices (EPI) that provide the vital signs of employees who wear them – pulse rate, muscle tension, etc. The common goal of these innovations: improve employees' working conditions.

TECHNOLOGY TO LIGHTEN LOADS

Innovative solutions can be trialled to improve the daily lives of technical and industrial teams. To relieve operators who have to adopt awkward postures when working, following tests on the Gravipack® solution, RER line A and tram line T2 maintenance operators were fitted with exoskeletons as part of a trial (see following page). Currently being industrialised, these exoskeletons are expected to equip several hundred operators. Another innovation consists of automatically driven and controlled carts to facilitate the movement of heavy loads. Trials of all new physical assistance technologies are monitored by ergonomists to gather employees' feedback and analyse the impact of these innovations on their working conditions.

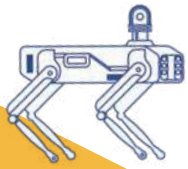
On-site trials with Gravipack prototypes.

OUR PROJECTS

Perceval, the robot dog

under the platforms

With Perceval, it has now become less risky and less tedious to inspect complex environments. “Trained” to probe the areas under platforms, underground tunnels or viaduct casings, this 84-cm-high robot dog measuring over one metre long carries the latest technology with it wherever it goes. Built-in cameras help Perceval to find its bearings and give it 360° day and night vision. Equipped with aerials to continuously receive signals, it can be fitted with a scanner to X-ray tunnels and view them in 3D. Developed by Boston Dynamics and unveiled by the Group at VivaTech in 2022, Perceval was awarded the *Grand Prix de l’Innovation de la Région Capitale de VRT* (Grand prize in innovation in the capital region’s VRT) that same year, placing innovation at the core of health and safety at work.



Exoskeleton

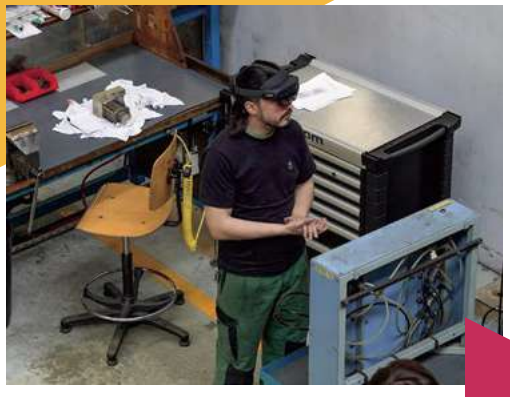
Relief during complicated operations

Improving the quality of employees’ working life, by easing the constraints involved in their duties and increasing their productivity, is what motivated the deployment of exoskeletons on the RER line A and tram line T2 maintenance sites. Following an individual technical training period, interested employees can then be fitted with an exoskeleton, which facilitates tasks that require them to work with raised arms by relieving muscular strain. These passive exoskeletons, which do not use any external energy and are built from elastomers and springs, follow the user’s movements. Other so-called “active” exoskeletons, powered by electricity or hydraulic energy, make it possible to exert more strength. These types are used in logistics to move heavy loads.

Remote assisted maintenance

with augmented reality

Augmented reality glasses may soon become maintenance operators' favourite work tool. During the trial phase of these glasses, staff working in the Saint-Fargeau and Saint-Ouen workshops were more accurately guided on the ground thanks to instructions fed by a remote expert and displayed in their line of sight. This innovation is set to further raise the efficiency and quality of maintenance operations, to become an invaluable tool as well in the training and autonomy of new hires.



Cargo bikes

to optimise maintenance operators' journeys

Winners in the participative innovation challenge organised across the Group, cargo bikes make it possible for maintenance staff to carry around equipment that is too bulky to be transported on foot or by public transport. And they can perform their duties without the hassles of unpredictable traffic conditions and parking. Following a four-month trial phase at the end of 2022, five employees now regularly use cargo bikes to reach their assigned work sites. The ultimate goal is to equip other employees and sites with these bikes.

Close to
200
assignments
completed with cargo bikes

Close to
190 km
of trips across Paris since the beginning of the trial

Developing new solutions in decarbonised mobility

Deep in the heart of regions, RATP Group leads cities and local authorities through a seamless ecological transition by offering an array of innovative initiatives to lower mobility's impact on the environment.

AUTONOMOUS MOBILITY AND NEW ENERGIES

In order to offer custom-fit mobility solutions that meet regions' specific needs, while reducing their carbon footprint, the Group regularly tests new transport modes. This is the key to developing mobility that continuously meets individual needs.

DEVELOPING AUTONOMY

Leader in urban and shared autonomous mobility, RATP Group has trialled a total of 15 solutions in various configurations across France and worldwide: in sparsely populated urban environments, city centres and tourist areas. These trials were opportunities for the Group to hone its expertise and rise up to major challenges, notably the deployment of an autonomous bus on route 393 between RER station Sucy-Bonneuil and tram station Carrefour de la Résistance in Thiais. A first in the country, and one of the first few in the world.

Trial of an autonomous bus on route 393.

2016
First trial of an autonomous shuttle on the Georges-Pompidou pedestrian walkway in Paris

2023
Operational deployment on bus route 393 with passenger reception; upcoming launch of the trial shuttle service between Bercy, Austerlitz and Gare de Lyon stations

ACCELERATED HYDROGEN POWER

In 2021, RATP Group commissioned its first hydrogen-powered buses in Roche-sur-Yon, currently being deployed in Lorient. Produced locally using fully renewable energy from wind turbines, this green energy source powers vehicles that release only water, thus reducing the carbon footprint of the Group's vehicle fleets. This field of innovation is crucial in an energy and climate crisis.

A COMMAND CENTRE DEDICATED TO AUTONOMOUS MOBILITY

Created in 2022 to process data gathered from smart devices, a new command centre in Paris' 12th arrondissement ensures that trial autonomous vehicles run as planned. Smart devices located in the Île-de-France region along the shuttles' routes provide a different, global view of the itinerary, regardless of the location of vehicles and their field of vision. These devices raise alerts that make it possible to anticipate delays, identify obstacles on the path, prevent malfunctions and lower risks. They constitute a precious tool that helps the fleet supervisor in the command post to make informed decisions on safety and the quality of service deployed.

IN SAUDI ARABIA, ALULA GEARS UP FOR A SMART, SUSTAINABLE NETWORK

A 360-Mobility service contract signed in December 2022 between RATP Dev and the Royal Commission for AlUla outlines plans to build a public smart and sustainable mobility network. The leading UNESCO World Heritage site in Saudi Arabia will receive autonomous shuttles to link up the old city centre and take visitors to historical sites, under the Saudi government's Vision 2030 plan. The service offer may be enriched with a next-generation tram network, a fleet of 200 fully electric buses, and a soft mobility offering (electric bikes and kick scooters), all of which can be booked and paid for via a MaaS (mobility as a service) app.

50% less

GHG emissions from bus traffic compared to 2015, by converting buses to renewable energy by 2025

INVENTING TOMORROW'S BUS DEPOTS

Backed by Île-de-France Mobilités and the European Commission under the Bus2025 programme, RATP Group has launched the large-scale conversion of its 4,700-bus fleet and bus depots to electricity and BioNGV. Along with the switch to electricity comes the real-time monitoring of bus charging and battery health, communicated to teams via digital supervision tools. The Group is also trialling an innovation designed to test the compatibility of terminals with buses from various manufacturers. The industrial transformation of its bus depots is also an opportunity for the Group to deploy more efficient energy solutions. Solar-powered systems are currently being installed at four bus depots to develop know-how and test energy capture in real-life conditions. Bus depots unoccupied during the day will host logistics operations during restricted hours, to maximise the use of space over the entire 24-hour cycle, and enable the deployment of more sustainable last-mile urban logistics solutions.

ACTIVE MOBILITY ON THE MOVE

In addition to other transport modes (bus, metro, tram, etc.), the Group offers bike rental and bike sharing solutions to provide its passengers with smooth journeys from start to end. This is the case in Brest and Laval, which are deploying fleets of electrically assisted bicycles to make cycling easier for local residents. The Group is also setting up dedicated parking solutions, in areas such as Aix-les-Bains, Annemasse and Angers, where bicycle shelters are integrated into the public transport network.

TRACTION CONVERTER EXOM – ONE STEP CLOSER TO ENERGY EFFICIENCY

The traction converter being trialled on metro line 5 recovers electrical braking energy from trains and distributes it back to the high voltage network, which in turn passes it on to other consumers on the grid. Exom is an advantageous way to reduce electricity consumption and the amount of particles released into the air by mechanical braking.

INSIGHT FROM THE EXPERT

Marina Escorne,
Head of traction energy studies and EXOM project manager

"We aim to deploy one or two converters per metro line, which would save up to 15 GWh per year, in line with the Group's energy efficiency goals."

Metro line 14

Innovation lab

Greater comfort, fewer decibels, welcoming stations, latest-generation passenger information and energy-efficient solutions... Welcome to metro line 14! Inaugurated in 1998 and currently being extended northwards and southwards, the fully automated metro line 14 is a concentration of passenger-oriented innovations and a world-class example that regularly receives foreign delegations.

Geothermal energy

The use of geothermal energy makes it possible to regulate the temperature in stations and release 50% less CO_2, 20% to 40% less sulphur dioxide and 40% less nitrogen oxide.

Passenger information

Smart façades on train platforms embed screens that indicate waiting times. On board trains, built-in screens display dynamic, real-time information that simplifies passengers' journeys.

Crowd management

At Gare de Lyon station, artificial intelligence is being tested to measure crowd levels and share such information with passengers, who can then choose to move to less crowded carriages.

METRO LINE 14 DECORATED WITH A 6TH EFQM STAR(1)

In 2023, metro line 14 was awarded the 6-star EFQM certificate issued by EFQM and Afnor. EQFM's internationally recognised R4E label is proof of its operational excellence and the soundness of the best practices implemented for its passengers, staff and the sustainable city. This makes line 14 the first metro line in the Paris region to achieve this level of excellence. Reaching this major, recognised benchmark in quality and managerial excellence demonstrates unprecedented performance with regard to the line's transformation.

(1) This level amounts to a score of over 600/1,000 points. The highest level ever reached among companies involved in the approach is the 7th star level.

Committing to a better quality of life in cities

RATP Group also innovates to ease the transformation of cities into calmer, more resilient spaces. Some of the initiatives include multiple projects to leave a lighter carbon footprint by saving energy and preserving resources with a more frugal approach, or through the creation of a dedicated programme, called Smarter City.

SMARTER CITY, OR HOW WE CONSOLIDATE EXPERTISE ACROSS THE GROUP

Sustained population growth, climate change and social divides are among the major challenges facing cities and compelling them to reinvent themselves. This is the challenge of the Smarter City innovation programme, which encourages cross-functional collaboration between the Group's different business lines in order to pool expertise around six key themes: decarbonisation, urban integration and logistics, new lifestyles, new forms of mobility and co-designing urban developments with passengers. The Smarter City programme is designed as an incubator for innovative ideas and trials, to build more sustainable, inclusive and peaceful cities together with local communities.

REUSING MINE WATER

Water stress represents a major challenge in the Île-de-France region. RATP Group takes actions regarding mine water – underground water recovered from natural events (rain, rising water tables) or human activity (works, leaking pipes, etc.). As the number one collector in the Île-de-France region, with over 8 million m^3 recovered yearly from drainage stations across the network, the Group has already established numerous recovery initiatives. Over a period of three years, 400,000 m^3 of non-drinking water has been used to water green spaces and clean roads, and to supply Paris' cooling network. In May 2023, RATP launched the first scientific consortium dedicated to the recovery of mine water, alongside its partners (Apur, ARS, Société du Grand Paris, Eau de Paris, and more). The company's main objective is to identify opportunities for reusing mine water, and to go even further in effectively managing the water in a resilient and concerted manner.

REUSING WASTE HEAT

The server cooling system accounts for over one-third of the energy consumed by data centres, regardless of the type of air conditioning system chosen. The waste heat emitted by the cooling unit is recovered and transformed into an energy source.

DEVELOPING UNDER-USED LAND

RATP Group considers the development of its industrial sites an opportunity to include a phase of transitional occupation of its land while setting up future projects. As a signatory of the "Charter for temporary and transitional occupation" initiated by the City of Paris, the Group undertakes to make its sites available for social, community, artistic and recreational projects as quickly as possible, and always with the aim to keep the neighbourhoods alive and to encourage the mixing of people and practices.

BLOWING HOT AND COLD AIR

Innovative systems have been put in place to recover energy from metro trains and stations. On metro line 11, for example, heat coming from the metro tunnels provides 35% of a building's heating needs. On metro line 14, geothermal energy is being tested to heat Porte de Clichy and Mairie de Saint-Ouen stations, resulting in a 50% reduction in CO_2 emissions. In Bagneux, the heat emitted by a data centre will be recovered beginning in 2026 to heat the future maintenance workshop on metro line 13 (Châtillon-Bagneux).
There is heating, but there is also cooling. With Fraîcheur de Paris, RATP Solutions Ville and Engie are developing Paris' cooling network, with the aim of cooling hospitals, crèches, schools, nursing homes, and more, with a highly efficient carbon footprint in order to meet the challenge of protecting the most vulnerable members of the population against the backdrop of global warming. As Europe's leading cooling network, it will almost triple in size over the next twenty years, adding more than 300 new buildings dedicated to health care.

REDUCING URBAN POLLUTION

Through its Bus2025 programme, RATP Group is rolling out electric fleets on its networks that are quieter and have a positive impact on the environment. This is a significant step that extends its commitment to testing new energies to reduce noise pollution even further. Considering that diesel will be banned in Paris from 2025, RATP Infrastructures is currently testing a hydrogen-powered generator to carry out night work on metro line 6, with clear benefits for local residents in terms of reduced noise and environmental pollution. The feasibility, risks, costs and performance gains are currently being analysed.

VAULTS 2.0 BY BIM(1)

Underground vaults are the hallmark of the Paris metro. They have become emblematic on the RER network (Étoile, Auber, and Nation stations), and RATP has launched major renovations on them. Similar to the corridors, whose geometries can enable infinite combinations, accurate and faithful 3D models are created using an RATP-designed tool used to industrialise this retro-digitisation. Used in augmented reality or virtual reality, these models help optimise resources dedicated to upgrading works. An innovative approach to be extended.

DEVELOP THE CIRCULAR ECONOMY

RATP Infrastructures is currently working with one of its suppliers in the Rail Open Lab association to recycle manganese track cores in order to limit their extraction and thus reduce their carbon impact. The aim of this full-scale trial is to identify the carbon gain from this recycling method in order to assess the new environmental targets when purchasing from suppliers.

(1) *Building information modeling.*

Designing the connected city of the future with Paris2Connect

Created by a consortium of companies to which RATP belongs, Paris2Connect is an innovative 5G-connected urban infrastructure that is fully operational along a 3.5-kilometre route in Paris' 12th and 13th arrondissements. Its goal: To develop new services aimed at reducing electricity consumption on public roads, making public spaces safer, improving road access for the blind and visually impaired, and promoting autonomous mobility.

Partnership with *École des ponts* on climate change

This research project, which was launched in 2023, aims to anticipate the impact of climate change on RATP Group's network and assets. Over a two-year period, the aim of the study is to characterise the transport network's vulnerability to climate hazards, based on the various IPCC scenarios. There will be two phases: a phase to identify the most at-risk infrastructures and structures, and a phase to analyse the hydrological, thermal and/or geological behaviour of the most vulnerable elements in order to measure the various existing adaptation solutions.

Serving the sustainable city with *Rêve de scènes urbaines*

Co-piloted by SNCF and RATP, the sustainable mobility business group is part of the *Rêve de Scènes urbaines* sustainable city industrial demonstrator, an original approach to cooperation between nearly 80 public and private players in the city to trial and produce innovative urban solutions in a context of ecological, energy, social and digital transitions, in order to develop inclusive mobility. Located in the Plaine Commune area (Seine-Saint-Denis), it is based on an open ecosystem, in which contributors have the shared goal to participate in the sustainable development of the area, for the benefit of residents' quality of life and the area's influence. A "cool island" bus stop, mapping to determine deficient access to essential services, energy supply management tools, and more. Every six months, Plaine Commune receives approximately 150 ideas for urban innovations, of which 20 to 30 are selected. These ideas are then the subject of a development study (technical feasibility of deployment, economic model, search for funding), which may lead to the production of a prototype.

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